# Fostering Sustainable Futures: The Role of Environmental Knowledge, Attitudes, and Perceived BehaviouralControl in Enhancing Awareness

Noor Asiah Hassan, Rodiah Mohd Hassan, Syed Lamsah Syed Chear, Hazmin Mansor, and Wan Shariza Wan Zainal Abidin

***Abstract*** **– This study examines the factors influencing environmental awareness among higher education students in Malaysia through a structural equation modelling (SEM) approach. A sample of 400 students was selected using a multistage sampling technique, ensuring representation from diverse institutions across the country. The proposed model explores the relationships between Environmental Knowledge (EnvK), Attitudes (Att), Perceived Behavioural Control (PBC), and Environmental Awareness (EA). Data were analysed using SPSS version 26.0 for preliminary statistical analysis and SEM AMOS version 24.0 for structural equation modelling. The findings reveal significant pathways linking EnvK to EA, both directly and indirectly, mediated by ATT and PBC, together explaining approximately 46% of the variance in awareness. The model demonstrates excellent fit indices (*P-Value* = 0.000, *RMSEA* = 0.057, *CFI* = 0.971, *TLI* = 0.966, *ChiSq/df* = 1.989), indicating its robustness in capturing the underlying relationships. Enhancing environmental awareness among higher education students is crucial, as it empowers future leaders to address pressing ecological challenges. This research contributes to the growing body of literature on pro-environmental behaviour in higher education and offers practical insights for policymakers and educators aiming to design effective environmental education programs.**

***Keywords*** **– Attitudes, Environmental Awareness, Environmental Knowledge, Perceived Behavioural Control, Structural Equation Modelling**

## I. INTRODUCTION

Environmental awareness is increasingly recognized as a crucial component in fostering sustainable practices and addressing global ecological challenges. As the world grapples with issues such as climate change, pollution, and biodiversity loss, the need for effective environmental education has never been more urgent. García-Salirrosas et al., (2024) indicates that instilling environmental awareness in students not only shapes their attitudes and behaviours but also empowers them to become proactive stewards of the planet. This is particularly relevant in higher education, where students are poised to become future leaders and decision-makers.

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Despite the growing emphasis on environmental education, there remains a significant gap in understanding how various factors influence environmental awareness among students. Dharmaraj et al., (2021) studies have primarily focused on the outcomes of environmental education rather than the underlying mechanisms that drive awareness. Specifically, the roles of attitudes and perceived behavioural control in mediating the relationship between environmental engagement and awareness have not been thoroughly explored. This gap highlights the need for a comprehensive investigation into these dynamics within the context of Malaysian higher education.

The objectives of this study are threefold: firstly, to examine the direct and indirect relationships between environmental knowledge, attitudes, perceived behavioural control, and environmental awareness as in Figure 1. Secondly, to identify how these factors interact to influence students' awareness levels; and thirdly, to provide practical insights for educators and policymakers aimed at enhancing environmental education programs. By addressing these objectives, this research aims to contribute valuable knowledge to the field of environmental education and inform strategies that promote sustainable behaviours among students.

In summary, understanding the pathways that link environmental engagement to awareness is essential for developing effective educational interventions. This study seeks to fill the existing gap in literature by employing a structural equation modelling approach to analyse these relationships among higher education students in Malaysia. Through this research, we aim to foster a generation of environmentally conscious individuals equipped with the knowledge and skills necessary to tackle pressing ecological challenges.

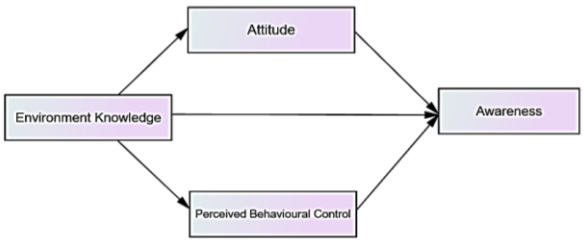


Figure 1. Conceptual framework of the study

## II. PROBLEM STATEMENT

Energy sustainability has become an urgent global concern, yet awareness of the issues remains inconsistent (Kathambi, 2023). While various initiatives aim to promote sustainability, simply disseminating information does not

necessarily lead to deeper awareness or meaningful engagement (Handayani et al., 2021). Awareness is most effective when knowledge, attitudes, and contextual support align, allowing individuals to translate understanding into action (Hassan et al., 2011). Systemic changes, such as simplifying sustainable choices and embedding environmental education into curricula, are essential in bridging the gap between awareness and behaviour (Linder et al., 2021). Without addressing both structural challenges and psychological barriers, sustainability messaging risks being superficial rather than fostering long-term behavioural change. Despite increasing research on sustainability awareness, the interplay between environmental knowledge, attitudes, and perceived behavioural control in shaping awareness remains underexplored, particularly in Asian contexts (Erwinsyah, 2022). Understanding this relationship is crucial for developing more effective strategies to enhance sustainability engagement.

## III. LITERATURE REVIEW

*Environment Knowledge (EnvK)*

Environmental knowledge plays a fundamental role in shaping individuals' understanding, attitudes, and behaviours toward sustainability (Neruja & Arulrajah, 2021). It refers to an individual's environmental literacy which include on systemic and action-related knowledge (Geiger et al., 2018). Environmental knowledge can be categorized into three main types: factual knowledge, which involves awareness of environmental facts such as climate change and pollution; procedural knowledge, which refers to the understanding of how to take environmentally responsible actions, such as recycling or conserving energy; and effectiveness knowledge, which involves recognizing which actions have the greatest impact in addressing environmental problems (Geiger et al., 2019).These different types of knowledge contribute to environmental awareness and influence how individuals perceive their role in sustainability efforts (Geiger et al., 2018).

Several studies have highlighted that environmental knowledge is a necessary but insufficient factor for promoting pro-environmental behaviour (Ahmad et al., 2010; Težak Damijanić et al., 2023). While knowledge provides the foundation for understanding environmental challenges, its influence depends on psychological factors such as attitudes, perceived behavioural control, external social and economic conditions (Muhammad & Soesilo, 2025; Težak Damijanić et al., 2023). This highlights the need to examine how knowledge interacts with attitudes and perceived behavioural control to enhance awareness and engagement in sustainability.

Additionally, most research on environmental knowledge is conducted in Western contexts, and there is a lack of localized studies exploring how knowledge influences awareness in developing countries such as Malaysia (Kamaruddin et al., 2019). The need for context-specific studies to understand how environmental knowledge shapes awareness and engagement in diverse societal settings is underscored by emerging research, particularly in non-Western contexts (Geiger et al., 2019; Janmaimool & Khajohnmanee, 2019). In conclusion, environmental knowledge is a crucial driver of sustainability awareness which influencing how individuals perceive and respond to environmental issues. However, its effectiveness is reinforced through contextual factors play a role in determining whether individuals take action.

*Awareness On Energy Sustainability (Ea)*

Awareness of environment sustainability is essential in fostering a culture of energy conservation, promoting the adoption of renewable energy sources, and encouraging individuals as well as organizations to reduce their carbon footprint (Muniz et al., 2023). While technological advancements have provided more energy-efficient solutions, research indicates that public awareness and behavioural change remain crucial factors in achieving long-term sustainability goals (Ma et al., 2023).

Energy sustainability awareness involves an individual's understanding of energy consumption patterns (Shen & Wang, 2022), the environmental consequences of excessive energy use, and the available strategies for conservation (Maurer & Bogner, 2020). Studies have shown that individuals with higher awareness of energy sustainability are more likely to engage in energy-saving behaviours, such as using energy-efficient appliances, reducing electricity waste, and supporting renewable energy initiatives (Jaciow et al., 2022). However, awareness alone does not always translate into action (Portus et al., 2024). Psychological factors such as attitudes, social norms, and perceived behavioural control influence the extent to which individuals adopt energy-saving practices (Ajzen, 1991). For instance, a person may be aware of the benefits of reducing energy consumption but may not change their behaviour due to a lack of motivation, convenience, or financial incentives (Gifford, 2011).

In conclusion, awareness of energy sustainability is a crucial component in addressing environmental challenges and promoting responsible energy consumption. While awareness campaigns and educational initiatives have successfully increased knowledge about energy conservation, additional measures such as behavioural interventions, policy incentives, and infrastructural support are necessary to translate awareness into meaningful action. This study seeks to examine the factors influencing awareness of energy sustainability and explore how knowledge, attitudes, and perceived behavioural control interact to shape energy-saving behaviours among individuals. By understanding these dynamics, more effective strategies can be developed to enhance energy sustainability efforts at both individual and societal levels.

*Attitude On Energy Sustainability (ATT)*

Attitude plays a crucial role in shaping individuals' engagement with energy sustainability. Attitude, defined as a psychological tendency expressed by evaluating an object or behaviour favourably or unfavourably (Ajzen, 1991), influences how individuals perceive, respond to, and adopt sustainable energy practices. In the context of energy sustainability, a positive attitude can drive pro-

environmental behaviours such as energy conservation, adoption of renewable energy, and support for policies that promote sustainable energy use (Asif et at., 2023). Conversely, negative attitudes, often shaped by convenience, perceived costs, or lack of trust in energy policies, can hinder sustainable energy practices despite increased awareness and knowledge (Steg & Vlek, 2009). Understanding the factors influencing attitudes toward energy sustainability is essential for designing effective interventions that encourage long-term commitment to energy conservation (Carrus et al., 2021).

A positive attitude toward energy sustainability is often linked to environmental concern and a sense of personal responsibility. Individuals who recognize the long-term consequences of excessive energy consumption, such as climate change and resource depletion, are more likely to develop a favourable attitude toward sustainable energy practices (Abrahamse et al., 2005; Han et al., 2022). Moreover, values such as altruism and ecological responsibility significantly contribute to shaping attitudes. Research suggests that individuals with strong pro-environmental values are more willing to make sacrifices, such as reducing energy use or investing in renewable energy technologies, even when these actions require financial or behavioural adjustments (Stern, 2000). However, attitudes are also influenced by social norms and cultural factors. Societies that emphasize collective well-being and environmental stewardship tend to foster stronger pro-sustainability attitudes than those prioritizing individual economic benefits (Gifford, 2011).

Despite increasing awareness of energy sustainability, many individuals still exhibit neutral or negative attitudes toward energy conservation due to perceived inconvenience and economic constraints. The perceived high cost of renewable energy technologies, such as solar panels and energy-efficient appliances, can discourage individuals from transitioning to sustainable energy sources (Mills & Schleich, 2012). Additionally, the belief that individual actions have little impact on global sustainability challenges, often referred to as the perceived behavioural control gap, weakens motivation to adopt energy-saving behaviours (Kollmuss & Agyeman, 2002). Research also highlights the role of misinformation and lack of trust in government policies in shaping public attitudes. When individuals are uncertain about the reliability or benefits of sustainable energy policies, they may resist behavioural changes or policy initiatives aimed at promoting energy conservation (Leiserowitz, Maibach, & Roser-Renouf, 2010).

Efforts to improve attitudes toward energy sustainability should focus on increasing public trust, making sustainable choices more accessible, and reinforcing positive social norms. Educational campaigns that highlight the financial and environmental benefits of sustainable energy practices can help reshape perceptions and reduce resistance to change (UNESCO, 2017). Additionally, government incentives such as subsidies for renewable energy adoption and energy-efficient technologies can make sustainability more economically viable, thereby improving attitudes toward sustainable energy choices (Stern, 2000). Community engagement and social influence also play a significant role; when individuals observe others in their community adopting energy-efficient practices, they are more likely to develop positive attitudes and follow similar behaviours (Cialdini, 2003).

In conclusion, attitudes toward energy sustainability significantly impact individuals' willingness to engage in energy-saving behaviour s. While positive attitudes can encourage responsible energy use, barriers such as perceived costs, misinformation, and lack of perceived behavioural control can hinder sustainability efforts. Addressing these barriers through education, incentives, and social reinforcement can help cultivate more favourable attitudes toward energy sustainability, ultimately contributing to a more sustainable future. Understanding the psychological and social factors influencing attitudes is key to developing effective strategies for long-term energy conservation and environmental responsibility.

*Perceived Behavioural Control (PBC)*

Perceived Behavioural Control (PBC) is a central construct in Ajzen's Theory of Planned Behaviour (TPB), defined as an individual's perception of the ease or difficulty of performing a particular behaviour, considering available resources, skills, and potential obstacles (Kotyza et al., 2024). PBC reflects control beliefs about the presence of factors that may facilitate or impede the performance of the behaviour (Ajzen, 2002). PBC is typically assessed through self-report questionnaires that gauge individuals' beliefs about their ability to perform a behaviour in specific contexts (Kotyza et al., 2024). These assessments often include items related to resource availability, perceived skills, and anticipated barriers. importantly, PBC is conceptually related to but distinct from self-efficacy as it encompasses both internal (skills, abilities) and external (opportunities, obstacles) control factors (Ajzen 1991; Rahmania, 2023). Within TPB, PBC operates alongside attitude toward the behaviour and subjective norms as a predictor of behavioural intention (Ajzen, 1991). Its unique contribution is to account for nonvolitional elements-those aspects of behaviour that may be outside the individual's full control (Barua, 2013). High PBC tends to strengthen the relationship between attitude and intention, while potentially moderating the influence of subjective norms (Barua, 2013).

*The Relationship Between EnvK and EA*

Environmental awareness is the cognitive and emotional recognition of environmental issues and their consequences. It serves as a crucial precursor to behaviour change, influencing whether individuals become actively engaged in sustainability efforts. Research has shown that environmental knowledge is one of the strongest predictors of awareness (Schultz, 2002), as individuals who understand the severity of environmental challenges are more likely to develop a heightened sense of urgency and responsibility (UNESCO, 2017). However, awareness does not automatically lead to behaviour change; it requires reinforcement through social influence, perceived control, and personal motivation (Stern, 2000).

Furthermore, studies highlight those different types of environmental knowledge (factual, conceptual, and

procedural) impact awareness differently. While factual knowledge (e.g., knowing about climate change) increases general awareness, procedural knowledge (e.g., knowing how to reduce carbon footprint) is more effective in fostering actionable awareness (Frick, Kaiser, & Wilson, 2004). This distinction suggests that environmental knowledge should not only focus on information dissemination but also on practical learning experiences that empower individuals to act. Thus, the first research question (RQ1) is formulated as follows:
RQ1: Is there a significant association between EK and the EA of Malaysian higher education students?

*The Relationship Between EnvK and ATT*

A substantial body of recent research demonstrates a consistent and positive relationship between environmental knowledge and environmental attitude, highlighting the mutual reinforcement between what individuals know about the environment and how they feel or act toward it. Meta-analytic findings indicate a moderate correlation between knowledge and environmental attitude, with a coefficient of approximately 0.37, suggesting that increases in environmental knowledge are generally associated with more positive environmental attitudes (Hernanda et al., 2023). Experimental and longitudinal studies further support this relationship. For example, participation in earth education programs has been shown to produce statistically significant gains in both environmental knowledge and attitude, with the convergence between these two variables strengthening after educational interventions (Baierl et al., 2022).

Moreover, mediation analyses reveal that environmental attitude can serve as a critical pathway through which environmental knowledge translates into pro-environmental behaviours, underscoring the attitudinal shift as a key mechanism in behavioural change (Liu & Han, 2020). Systematic reviews of school-based research confirm that environmental knowledge not only directly influences attitudes but also indirectly shapes them through increased awareness and behavioural engagement, in line with the Theory of Planned Behaviour (Firmanshah et al., 2023). Additional empirical work has found that both attitude toward nature and environmental attitude predict the extent of environmental knowledge gained and retained by students, with environmental attitude fully mediating the effect of nature appreciation on knowledge acquisition (Baierl et al., 2024).

These findings collectively suggest that educational strategies aiming to improve environmental outcomes should integrate both knowledge-building and attitude-strengthening components, as each reinforces the other and together promote deeper and more sustained engagement with environmental issues (Nkaizirwa et al., 2022). Hence, the next research question (RQ2) was formulated as follows:
RQ2: Is there a significant association between EK and the attitude (ATT) held by Malaysian university students?

*The Relationship Between EnvK and PBC*

Recent research highlights a strong relationship between environmental knowledge and perceived behavioural control (PBC) in the context of pro-environmental behaviours. Individuals who possess greater knowledge about environmental issues and solutions often feel more capable of taking effective action, which enhances their sense of control over environmentally responsible behaviours. For example, a study by Wang et al. (2023) found that environmental knowledge significantly predicted PBC among university students, suggesting that as individuals become more informed about environmental challenges and practical solutions, they are more likely to perceive themselves as able to engage in sustainable actions. Similarly, research by Zhang et al. (2022) demonstrated that environmental education programs, by increasing knowledge, also contributed to higher levels of PBC, thereby fostering greater intention to participate in recycling and energy-saving behaviours. These findings indicate that educational interventions aimed at increasing environmental knowledge can play a crucial role in strengthening individuals perceived behavioural control, ultimately promoting more consistent pro-environmental actions. Thus, the third research question:
RQ3: Is there a significant relationship between EK towards PBC of Malaysian students of higher institutions?

*The Relationship Between ATT and EA*

Recent research demonstrates a nuanced but generally positive relationship between environmental awareness and attitudes toward the environment, though the strength and nature of this relationship can vary across contexts and populations. Multiple studies have found that higher levels of environmental awareness are associated with more positive environmental attitudes. For instance, a survey of residents in Bangkok revealed a significant positive correlation between environmental awareness and environmental attitudes, indicating that individuals who are more aware of environmental issues tend to hold more favourable attitudes toward environmental protection (Phuphisith et al., 2020). Similarly, Zheng et al. (2018) found a positive correlation between environmental knowledge, awareness, and attitude, suggesting that increasing awareness can foster more supportive attitudes toward environmental initiatives (Zheng et al., 2018).
However, not all studies report a strong or direct relationship. A systematic review by Makhtar et al. (2021) and Arshad et al. (2020) found mixed results, with some research indicating no significant correlation between environmental attitude and awareness, while others observed a positive link (Firmanshah et al., 2023). These discrepancies may be due to differences in participant characteristics or regional variations. Nonetheless, path analysis and correlation studies in various settings, including among Iranian students and Brazilian university students, consistently highlight that environmental awareness and attitudes are interrelated and often reinforce each other, especially when supported by educational

interventions or targeted communication strategies (Shahi et al., 2021; Amérigo et al., 2017).

Moreover, research underscores that both environmental awareness and attitudes are important predictors of pro-environmental behaviours, with their combined influence often exceeding the effect of knowledge alone (Phuphisith et al., 2020). This body of evidence suggests that enhancing environmental awareness through education and outreach can be an effective strategy for cultivating more positive environmental attitudes which in turn may lead to greater engagement in sustainable behaviours. This leads to the fourth research question:

RQ4: Is there a significant relationship between students' attitude (ATT) and their awareness on environment sustainability (EA)?

*The Relationship Between PBC and EA*

Recent studies underscore a robust relationship between perceived behavioural control (PBC) and environmental sustainability awareness, highlighting how increased awareness of environment issues enhances individuals' confidence in their ability to adopt sustainable practices. For instance, Wang et al. (2023) found that environmental literacy programs significantly improved both awareness and PBC among university students with heightened awareness directly strengthening participants' belief in their capacity to engage in recycling, waste reduction, and energy conservation. Zhang et al. (2022) demonstrated that awareness of local environmental policies amplified PBC enabling individuals to navigate structural barriers and adopt sustainable behaviours such as composting or using public transportation.

The mediating role of PBC is critical in translating awareness into action. Correia et al. (2022) identified PBC as a primary mediator between environmental knowledge (a core component of awareness) and pro-environmental intentions, particularly in institutional settings like universities, where resource accessibility reinforces perceived control. Bamberg (2023) further emphasized that awareness campaigns targeting specific behaviours-such as plastic reduction or water conservation-indirectly boost PBC by clarifying actionable steps and available resources, thereby bridging the gap between intention and behaviour. Cross-cultural studies, such as those by Li et al. (2021) in urban China revealed that environmental awareness campaigns not only increase PBC but also foster collective efficacy empowering communities to advocate for systemic sustainability changes.

However, the strength of this relationship depends on contextual factors. Makhtar et al. (2021) noted that while awareness correlates with PBC, its impact is moderated by institutional support; for example, students in schools with recycling infrastructure reported stronger PBC than those lacking such resources. Arshad et al. (2020) similarly found that awareness alone is insufficient without skill-building interventions to address perceived barriers like cost or convenience. These findings align with Ajzen's (2020) updated TPB framework, which emphasizes that PBC thrives when awareness is paired with accessible tools, such as apps tracking carbon footprints or community workshops on sustainable living.

In addition, the interplay between environmental awareness and PBC can be bidirectional which awareness equips individuals with the knowledge to assess their control over sustainable actions, while strong PBC motivates further engagement with environmental issues. Therefore, the next research question (RQ5) was formulated as follows:

RQ5: Is there a significant association between PBC and the awareness on held by Malaysian university students?

## IV. METHOD

The current research employs a cross-sectional causal research design to explore how alterations in independent variables are expected to influence the dependent variable. Information was gathered from a sample of 400 lecturers working in Malaysian higher education institutions, utilizing a multistage sampling approach to ensure more representative sample selection.

*Instrument And Questionnaires*

Data for this study were collected using a standardized closed-ended questionnaire. Table I provides an overview of the number of items utilized for each subconstruct, the sources of adapted questionnaires, and the scale intervals. The final part of the questionnaire focuses on gathering demographic information from the respondents.

**TABLE I. RESEARCH INSTRUMENTS UTILIZED**

| Construct | No of items | Adapted from | Scale |
|---|---|---|---|
| **EnvK** | 6 | | |
| **ATT** | 5 | Hassan et al., (2024) | 1-10 |
| **PBC** | 4 | | |
| **EA** | 4 | Macovei (2015) | 1-10 |

*Demographic Characteristics*

The study involved a total of 400 students, comprising 46.2% males (n = 140) and 53.8% females (n = 163). A majority of the participants (66.0%, n = 200) were enrolled in science-related programs, while the remaining 34.0% (n = 103) came from non-science fields. In terms of age, 17.2% (n = 52) were between 18 and 19 years old, 24.8% (n = 67) were aged 20 to 21, 37.0% (n = 93) fell within the 22 to 23 age range, and 30.0% (n = 91) were between 24 and 25 years old.

## V. FINDINGS

*Descriptive Statistics*

The descriptive analysis of the constructs outlined by Best and Khan (1977) reveals generally high levels across all measured variables, indicating positive perceptions among the respondents. Table II indicates that Environmental Knowledge (EnvK) recorded an average mean of 6.77 with a standard deviation of 1.99, reflecting a

high level of awareness, though with more varied responses compared to other constructs. Perceived Behavioural Control (PBC) and Environmental Awareness (EA) both achieved identical mean scores of 7.56, with standard deviations of 1.23 and 1.36, respectively. These results suggest a strong and consistent belief among participants in their ability to engage in environmentally responsible behaviour and a clear awareness of environmental issues. The construct with the highest mean score was Attitude (ATT), with a mean of 8.64 and a relatively low standard deviation of 1.06 indicating a very high and uniform positive attitude toward energy conservation. Overall, the data suggest that the participants demonstrate strong environmental values and behavioural intentions, with particularly positive attitudes serving as a potential driving force for pro-environmental actions.

**TABLE II. THE AVERAGE MEAN OF ALL CONSTRUCTS**

| Constructs | Average Mean | Std. Dev | Indicator |
|---|---|---|---|
| EnvK | 6.77 | 1.99 | High |
| PBC | 7.56 | 1.23 | High |
| EA | 7.56 | 1.36 | High |
| ATT | 8.64 | 1.06 | Very high |

*Confirmatory Factor Analysis Result*

For the inferential analysis, this study employed Structural Equation Modeling (SEM), beginning with Confirmatory Factor Analysis (CFA) prior to testing the hypothesized model. As shown in Figure 2, the measurement model met the necessary criteria for construct validity, aligning with the minimum fit indices recommended by Hair et al. (2014). Detailed information on these indices is available in Table III. Table IV outlines the factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR), confirming that the model meets the requirement of unidimensionality.

Additionally, the measurement model demonstrated adequate convergent validity and reliability, as both CR and AVE values exceeded the recommended thresholds of 0.6 and 0.5, respectively. The correlations among the four constructs, while similar in magnitude were distinct indicating varying relationships between them. Importantly, none of the correlation coefficients surpassed the 0.90 threshold suggesting that multicollinearity is not a concern and supporting discriminant validity as evidenced in Table V.

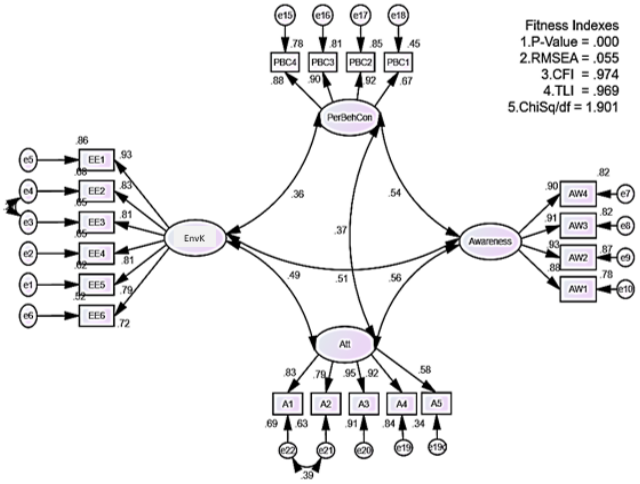


Figure 2. The Pooled-CFA Results to validate four constructs simultaneously

**TABLE III: THE ASSESSMENT OF FIT FOR THE MEASUREMENT MODEL**

| Category | Name of Index | Present model | Comment |
|---|---|---|---|
| **Parsimonious Fit** | Chisq/df | 1.90 | Min requirement < 3.0 |
| **Incremental fit** | CFI | 0.97 | Min requirement > .85 |
| | TLI | 0.97 | Min requirement > .85 |
| **Absolute fit** | RMSEA | 0.06 | Min requirement < 0.1 |

**TABLE IV: VALIDITY AND RELIABILITY TEST OF THE MEASUREMENT MODEL**

| Construct | Item | Factor Loading | CR (> 0.6) | AVE (> 0.5) |
|---|---|---|---|---|
| **EnvK** | EE1 | 0.93 | 0.89 | 0.68 |
| | EE2 | 0.83 | | |
| | EE3 | 0.81 | | |
| | EE4 | 0.81 | | |
| | EE5 | 0.79 | | |
| | EE6 | 0.72 | | |
| **PBC** | PBC1 | 0.67 | 0.88 | 0.67 |
| | PBC2 | 0.92 | | |
| | PBC3 | 0.90 | | |
| | PBC4 | 0.88 | | |
| **ATT** | A1 | 0.83 | 0.85 | 0.66 |
| | A2 | 0.79 | | |
| | A3 | 0.95 | | |
| | A4 | 0.92 | | |
| | A5 | 0.58 | | |
| **EA** | AW1 | 0.88 | 0.90 | 0.71 |
| | AW2 | 0.93 | | |
| | AW3 | 0.91 | | |
| | AW4 | 0.90 | | |

**TABLE V: SUMMARY OF DISCRIMINANT VALIDITY**

| Construct | EnvK | PBC | ATT | EA |
|---|---|---|---|---|
| **EnvK** | ***0.68*** | | | |
| **PBC** | 0.36 | ***0.67*** | | |
| **ATT** | 0.49 | 0.37 | ***0.66*** | |
| **EA** | 0.51 | 0.54 | 0.56 | ***0.71*** |

*Model Testing*

Figure 3 presents the standardized regression paths among the constructs, and Table VI reports the corresponding coefficients and significance levels. All hypothesized relationships in the structural model were statistically significant at $p < .001$. Overall, the structural model supports all proposed hypotheses with the strongest effect observed from Environmental Knowledge to Attitude. The significance and strength of these relationships underscore the multidimensional nature of pro-environmental awareness and align with the theoretical framework guiding the study.

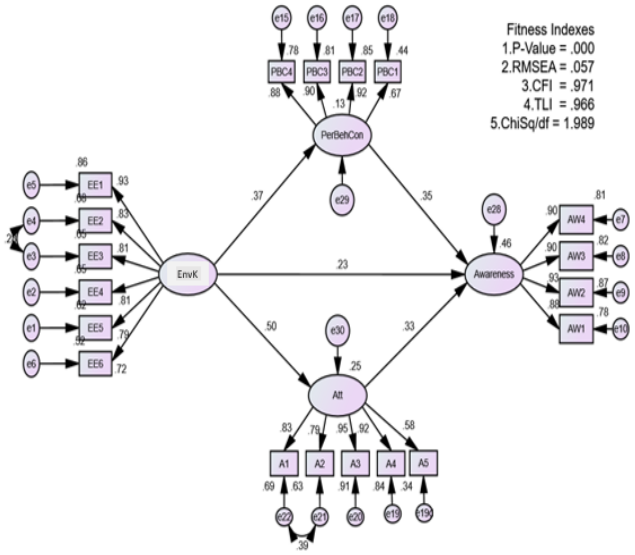


Figure 3. The Standardized Regression Path Coefficient among constructs in the model

**TABLE VI. THE REGRESSION COEFFICIENT AND ITS SIGNIFICANCE**

| Construct | Path | Construct | Std. est. | *p*-value | Result |
|---|---|---|---|---|---|
| PerBehCon | <--- | EnvE | 0.37 | *** | Significant |
| Att | <--- | EnvE | 0.50 | *** | Significant |
| Awareness | <--- | PerBehCon | 0.35 | *** | Significant |
| Awareness | <--- | Att | 0.33 | *** | Significant |
| Awareness | <--- | EnvE | 0.23 | *** | Significant |

## VI. DISCUSSION

The findings of this study provide compelling evidence that environmental knowledge (EnvK), attitudes (Att), and perceived behavioural control (PBC) significantly influence environmental awareness (EA) among higher education lecturers in Malaysia. The structural equation modelling revealed that all proposed relationships were statistically significant confirming the robustness of the model.

Firstly, environmental knowledge exhibited a strong direct effect on environmental awareness ($\beta = 0.23$, $p < .001$), and even stronger indirect effects through attitudes ($\beta = 0.50$, $p < .001$) and perceived behavioural control ($\beta = 0.37$, $p < .001$). This highlights the critical role of knowledge as a foundational component for cultivating awareness. The results align with previous research (e.g., Geiger et al., 2019; Wang et al., 2023), which underscores that individuals with greater environmental knowledge tend to recognize ecological problems more acutely and are more likely to adopt sustainable practices. However, as knowledge alone may not suffice, the mediation pathways through ATT and PBC provide key mechanisms for how knowledge translates into deeper awareness and potentially behaviour.

Secondly, attitudes toward sustainability demonstrated a significant predictive role for awareness ($\beta = 0.33$, $p < .001$). This confirms the notion that positive environmental attitudes can be shaped by personal values, social norms, and perceived responsibilities which greatly enhance an individual's engagement with sustainability issues. This is consistent with Ajzen's Theory of Planned Behaviour (1991), which posits attitudes as a major driver of behavioural intentions. The high mean score for attitude ($M = 8.64$) among respondents suggests a favorable disposition toward environmental matters, likely influenced by prior exposure to sustainability education or institutional culture.

Thirdly, perceived behavioural control significantly influenced awareness ($\beta = 0.35$, $p < .001$), indicating that lecturers who perceive greater control over their ability to engage in sustainable behaviours are also more aware of environmental issues. This finding supports the idea that both internal resources (e.g., knowledge and skills) and external support (e.g., institutional infrastructure) are critical in empowering individuals to act sustainably. As highlighted by Zhang et al. (2022), the belief in one's capability to perform pro-environmental behaviours is enhanced by education and access to enabling environments.

Collectively, the model accounted for approximately 46% of the variance in environmental awareness, a substantial figure that validates the integrative approach of combining cognitive (knowledge), affective (attitude), and control (PBC) dimensions. The model fit indices (CFI = 0.971, RMSEA = 0.057) further affirm the strength and validity of the conceptual framework.

## VII. CONCLUSION

This study contributes to the understanding of the psychological and contextual factors that shape environmental awareness among higher education staff. It demonstrates that enhancing environmental knowledge is a necessary foundation, but its impact is maximized when coupled with positive attitudes and strong perceived behavioural control. These findings have practical implications for curriculum designers, institutional leaders, and policymakers seeking to cultivate a sustainability-oriented culture in higher education.

Programs aiming to boost environmental awareness should adopt a holistic approach by:

1. Embedding environmental knowledge in academic and professional training;
2. Promoting positive environmental attitudes through values-driven education; and

3. Strengthening perceived behavioural control by improving institutional support and providing accessible sustainability tools.

Ultimately, fostering environmental awareness through an integrated model will empower educators not only to understand but to act upon environmental challenges further influencing future generations. This is a crucial step toward building a sustainable and environmentally responsible society.

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